STATION INSTALLATIONS

Contents

1. GENERAL

1.1 This section provides REA Borrowers, consulting engineers, contractors, and other interested parties with technical information for use in the design and construction of REA Borrowers' telephone systems. It discusses methods and practices for installation of conventional subscriber station facilities.

1.2 This section replaces Issue No. 4, dated June 1967. It has been revised to comply with the requirements of the October 1973 issue of "Specification and Drawings for Station Installations," REA Form 511g; the 1975 National Electrical Code (NEC): and the 1973 edition of the National Electrical Safety Code (NESC).

1.3 Items in this section which involve planning and decision making are directed to the borrower's engineer if station installations are included in the project design staking sheets. Stakers should not be delegated responsibility for planning station installations unless they are thoroughly familiar with this TE & CM Section.

1.4 Where station installations are excluded from the construction contract and responsibility for them is assumed by the borrower, the manager, plant superintendent, or installation foreman should be made responsible for station installations and should be well informed regarding the contents of this section and REA Standard PC-5, "Station Installations." Installers should not be considered qualified to make decisions regarding type and routing of service (aerial or buried), protector location, selection of ground electrodes, or installation of house cables unless they are completely familiar with the contents of this section and PC-5.

1.5 Material formerly covered in this section which is of interest primarily to installers has been removed and is now contained in PC-5.

1.6 The Engineer or other person delegated responsibility for station installations should familarize himself with the contents of the following publications which are referenced in this section:

REA TE & CM Sections:

602: Clearances
640: Design of Buried Plant
641: Construction of Buried Plant
642: Staking of Buried Plant
702: Booths and Special Fittings
703: Pay Station Services
704: Key Telephone Systems
707: Station Equipment Aspects of Automatic Number Identification
805: Subscriber Station Protection
823: Use of Gas Tube Arresters

REA Specifications and Standards:

BULLETIN NO.	SPECIFICATION NO.	TITLE
345-6	PC-2	Splicing Plastic-Insulated Cable
345-63	PC-4	Acceptance Tests and Measurements of Telephone Plant
345-52	PC-5	Station Installations
345-36	PE-7	Parallel Conductor Drop Wire
345-18	PE-20	Station Wire
345-67	PE-39	Filled Telephone Cables
345-70	PE-54	Filled Buried Distribution Wire
345-59	PE-71	Inside Wiring Cable

OTHER REA PUBLICATIONS:

REA Form 511g: "Specifications and Drawings for Station Installations"
REA Publication filed with TE & CM-640: "Design and Construction, of Joint Buried Plant-Electric and Telephone."
REA Bulletin 344-2: "List of Materials Acceptable for Use on Telephone Systems of REA Borrowers."

1.7 References to Construction Drawings in this section apply to the applicable drawings in the October 1973 issue of REA Form 511a and 511g.

2. SYSTEM POLARITY

2.1 Battery polarity and conductor identification (tip, ring, and ground) should be maintained throughout the system by observing rules for position, color, or tracer when terminating drop, service, and station wire conductors. The rules for various types of facilities, terminating devices, and polarity requirements are specified in PC-5.

2.2 Telephone set line cord connections should be made in accordance with the manufacturer's instructions.

3. SERVICES - BURIED PLANT

3.01 Buried services should be considered to be the normal service facility associated with buried line plant. Aerial drops from buried main line plant should not be used except where economics or unusual circumstances make buried services impracticable. Examples of "impracticable" situations are where the subsurface is rock, or where the road is in a narrow cut that makes it unusually expensive to set up augering or pipe pushing operations. Where normal costs of $4 - $5 per foot for the underground pipe or non-pipe crossing assembly unit can be realized, buried crossings should be used even though more expensive than aerial crossings. This prevents or minimizes exposures to power contacts and storm damage. Where a major highway or railway is involved and customers must be served on both sides, distribution lines constructed on both sides of the right-of-way should be considered preferable to numerous service crossings (either aerial or buried).

3.011 For the usual situation of rural distribution along a two lane paved secondary road, the use of an "Underground Pipe Crossing Assembly Unit" (BM61) is recommended for most buried services. Where practicable several buried services should cross the road in the same pipe or hole to limit the number of crossing units to the practical minimum. One inch diameter steel pipe should be used (if it can be pushed) where not more than three two pair services or one 12 pair 22 gauge cable is anticipated in ten years.

3.02 Buried plant housing locations should be carefully selected to facilitate serving the maximum practical number of establishments from each housing. The location of the station protector at each establish-

ment and the routing of each buried service across the customer's property should be considered at the same time the buried plant housing is located. Care should be exercised to select a route which will minimize damage and disturbance of the customer's premises. The protector should be located inconspicuously on the side or back of the building if practicable. Consideration should also be given to security systems aspects, future maintenance, permanency and accessibility of the facilities.

3.03 In determining the size of buried services to be used, the future requirements of each customer should be taken into consideration. The probability of providing additional lines by carrier should also be considered. The incremental costs of including spare pairs during the initial installation will be far less than adding pairs sometime in the future. Spare pairs may not cost significantly more than installing only the initially required number of pairs. It is for this reason that installation of a minimum two pair 22 AWG filled buried wire is recommended for those customers whose initial requirement is only one line.

3.031 The "REA Telephone System Construction Contract" (Form 511) requires that all buried services be either filled wire conforming to specification PE-54, or filled cable conforming to specification PE-39.

3.04 With existing plant, buried service wires should be taken from the nearest available buried plant housing on the main wire or cable lead. Where no conveniently located buried plant housing exists, buried wire should be plowed or trenched, parallel to the main lead from the nearest housing on the main lead to the point where the route into the customer's premises leaves the main lead. From this point proceed as indicated 3.06. Care should be exercised to accurately locate existing facilities to avoid digging into them.

3.05 Termination of buried service facilities should be in accordance with REA Standards PC-2 and PC-5. When a buried service wire is installed with one or more spare pairs, the spare pair(s) should be left floating at both ends (See Paragraph 5.5.) The buried service wire should be identified at the buried plant housing in accordance with Construction Drawing 958.

3.06 When extending buried services from buried plant housings to customers' premises, the same general procedures should be followed as for burying any other wire or cable except that heavy equipment should not be used on lawns, flower beds, or gardens. Special lightweight lawn plows, or trenchers, should be used for this purpose. Equipment selection should be based on obtaining the maximum practical depth of burial which is consistent with a reasonable amount of disturbance to the property.

3.07 The specific route and depth of the buried service across the customer's property should be selected after determining the location of the facilities of other utilities, and after consultation with the owner regarding other underground structures and hazards. If flower beds, cultivated

areas, or ornamental shrubs or trees are involved along the proposed route it would be advisable to obtain permission in writing from the owner. The agreement should specify if plants must be removed and replaced, and if so, who is responsible for doing the work. Care should be exercised to avoid routing buried services across private property other than the property being served.

3.08 If a suitable service entrance conduit is available, it should be used. The station protector may then be located in a buried plant housing or mobile home post at the outer end of the conduit, or inside the building. While not generally recommended, inside mounted protectors may be used on one party lines if local conditions make outside mounted protectors impractical. Inside mounted protectors should be used wherever a security alarm system is involved.

3.09 Where no suitable service conduit has been provided, a plowed or trenched buried service is preferred.

3.10 Where joint buried telephone and power services are being considered, REA publication "Design and Construction of Joint Buried Plant-Electric and Telephone," should be followed.

3.11 Experience indicates that many owners of buildings that have been covered with aluminum or plastic siding object strenuously to holes being drilled in the siding for attaching wires and station protectors. It is, therefore, important to obtain permission from the owner before drilling holes in such siding.

4. SERVICES-AERIAL PLANT

4.1 Buried services from aerial plant are generally recommended wherever economical and practical.

4.11 Situations where buried services from aerial line plant are specifically preferred are listed below:

a) Areas subject to frequent severe wind and/or ice storms.
b) Where it is not practical to obtain required ground clearance.
c) Where aerial services would be objectionable from security considerations.
d) Where severe tree conditions exist.

4.2 Aerial drop wire routes should be planned in order to achieve proper sag, clearances, and station protector location in accordance with REA TE & CM-602, REA Form 511g, and PC-5. Aerial drop wires must meet the NESC clearance requirements for poles and spans, the NEC clearance requirements on and in buildings, or State and local requirements, which ever are the most stringent.

4.3 Aerial services should consist of parallel drop wire complying with REA specification PE-7. Drop wires from aerial plant should be installed in accordance with PC-5.

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4.3 Aerial services should consist of parallel drop wire complying with REA specification PE-7. Drop wires from aerial plant should be installed in accordance with PC-5.

5. STATION PROTECTION

5.1 Station protectors and grounds should be located and installed as described in REA TE & CM-805, and as shown in REA Form 511g and PC-5. The selection of protector grounding units should be in accordance with Table 1 or Table 1A. Station protector and ground installations should meet all applicable requirements of the latest issue of the NEC or local laws or ordinances, whichever are more stringent. No NEC fusing coordination requirements apply to non-joint circuits buried throughout their entire length because there is no power exposure. However, protectors are required by REA for lightning protection. NEC fusing coordination requirements between aerial line plant and aerial drops are given in Table 2. For circuits that are partly buried and partly aerial see TE & CM-805.

5.2 The selection of the protector location should be made with primary emphasis on common grounding of the telephone protector with the power system ground and the water system. Common grounding of the power and telephone systems is required by the 1971 and 1975 editions of the NEC.

5.3 Fuseless type station protectors equipped with air-gap carbon arresters should be specified for most installations if the NEC requirements for fuseless station protectors can be met. Fused type protectors are required only at stations served by open wire and aerial distribution wire where there is no suitable water pipe electrode, and no MGN type electric service ground (See TE & CM-805). Uninsulated attachments may be used on drop wires for all installations of fuseless station protectors, and with fused type protectors on masonry (stone, brick, cinder block, or concrete) buildings. Insulated attachments and increased clearances are required if fused type protectors are used on flammable buildings.

5.4 Gas tube station protectors, accepted by REA, should be used in place of fuseless carbon block station protectors in locations where experience has shown maintenance cost of carbon blocks to be excessive. As labor and vehicle expenses increase a fewer number of grounded carbons equate to "excessive". Gas tube station protector installations are subject to the same requirements as are applicable to fuseless station protectors equipped with carbon arresters. Gas tube station protectors should be equipped with nominal 350V dc or equivalent breakdown tubes (See TE & CM-823).

5.5 Where more than one physical line is required initially, a multi-pair type station protector equipped to protect the number of physical circuits required or anticipated within the next two years should be installed.

6. STATION WIRING-SMALL INSTALLATIONS

6.1 Where voice frequency only service from one or two lines is required in a residence or other small building, it is recommended that station wiring between the protector and each main station be a four conductor type conforming with REA specification PE-20. Three conductor wire is available and may be used for one line ANI or grounded ringing but

is not generally recommended. Station wiring between the protector (or a main station) and an extension station may be four, three, or two conductor. Two conductor station wire is about 25% less expensive than four conductor station wire but the material cost of any of the three types is only a small part of the total installation cost.

6.2 The best practical installation from overall considerations should be obtained. This includes giving adequate consideration to the installer's problems of routing and installing the station wire in the most practical way. Other considerations include safety, complying with code requirements, future maintenance, appearance, economic factors, and the customer's wishes.

6.21 If wiring conduits or channels are available they should be used to the extent practicable.

6.22 Where no conduits or channels are available maximum use should be made of unfinished basements, unfinished attached garages, utility rooms, crawl spaces, and attics for running station wire, thereby minimizing exposed wire runs in finished rooms. Station wire may be run on the outside of buildings but will have a shorter life because of weathering.

6.23 Where the methods discussed above are impracticable, station wire may be run in finished rooms along baseboards and door frames. Fishing wires under floors, is usually time consuming, therefore costly, and should be avoided in most instances. In situations where exposed wiring is objectionable, and where it appears practicable to fish the wires in a reasonable length of time it should be done. For example, if wiring is run in an attic it can probably be dropped down inside a partition wall and fished out at the appropriate point in a reasonable length of time. This would avoid an unsightly exposed run on the surface of a finished wall. However, where a telephone is to be located in the middle of a room which has floor joists but no access beneath the floor, fishing a wire under the floor from a wall location to a mid-room location can be very time consuming.

6.24 Wherever practicable, new buildings should be prewired during the construction stage. Prewiring should include installation of jacks if an advance commitment to rent jacks can be obtained from the customer. Prewiring techniques are discussed in PC-5.

7. STATION WIRING AND CABLING-LARGE INSTALLATIONS

7.01 Where two or more physical lines and/or special station equipment is required in any type of building, inside wiring cable conforming with REA specification PE-71 should be considered in addition to station wire runs. Installation of inside wiring cable involves somewhat different techniques than are required for station wires and considerably greater expense. In order to hold the investment cost to a reasonable level it is important that an adequate terminal box and duct or conduit system be built into the building. It is also important that adequate space be dedicated for telephone power and switching equipment.

7.02 It is most important that the Manager of the telephone company make a practice of finding out about plans to construct new buildings in his area, during the early planning stages and that he work with the architect to assure that adequate provision is made for telephone facilities.

7.03 Comprehensive planning of installations in both new and existing buildings, by the Engineer, Manager, or Plant Superintendent is needed. Planning should include preparation of a detailed layout plan of the proposed facilities. The plan should show the following:

a) Cable entrance point
b) Type, size, and gauge of the entrance cable
c) Location of protectors and inside wiring terminals
d) Type and number of protectors
e) Size and type of grounding conductors and ground electrodes
f) Type, size, and route of ducts and conductors
g) Cable routing, and location on walls
h) Method of attachment of cables
i) Location of equipment closets and list of equipment in each closet
j) Location, type, and rating of power supply outlets
k) Designated pairs to be terminated in each cable terminal
l) Method of terminating cable pairs at each station
m) Type and quantity of station equipment at each station
n) Service features at each station

7.031 The building owner's concurrences with the plan should be obtained. The necessary work orders should be prepared, all necessary materials should be on hand, and an adequate labor force should be assigned to the job before starting work. Careful consideration should be given to both the initial and probable future demands for service, including the possibility that the customer at some future date may elect to own both the station equipment and the wiring. A binding agreement protecting the telephone company's investment should be obtained from the customer before proceeding with plans for an extensive cabling system in a building.

7.04 Where station wire runs are involved in portions of large installations, the same general guide lines that are given in Paragraph 6 above, would apply. Where cable must be placed, and where duct or conduit runs are involved the following paragraphs apply.

7.05 Station wire and cable should be installed in accordance with PC-5. Polyethylene jacketed wire and cables should not be run in buildings because of the fire hazard.

7.06 Station wire and inside wiring cable should be used in pre-wiring buildings during construction.

7.07 The NEC requires that runs of telephone conductors or cable "shall be so made that the possible spread of fire or products of combustion through fire-rated, fire-resistant, or fire-stopped walls, partitions, ceilings and floors, hollow spaces; vertical shafts; and ventilating or air-handling ducts will not be substantially increased."

7.08 Station wire or inside wiring cable may be used for vertical runs in building riser shafts. When providing vertical runs in closed riser shafts, approved fire stops should be used at each floor level. A closed riser shaft is one which is blocked by substantial building materials at each floor. An approved fire stop consists of a packing of asbestos or fibre glass material with a topping of water plug cement or equivalent topping material, placed around the cable to seal the hole through the floor and ceiling. In buildings which have an extensive environmental air duct system it is permissible to run house cables in the large air ducts provided they are enclosed in a conduit. The NEC does not permit telephone cables to be run in ducts used for the removal of dust, loose stock, or vapor.

7.09 Some office and other multiple occupancy buildings are equipped with an entrance conduit providing access from the outside to an in-house terminal on the ground floor. Distribution terminals or cabinets are usually located on each floor and are connected to the main terminal by conduits. These facilities should be used whenever practical.

7.10 Wire distributing systems in apartment houses, hotels, motels, and hospitals, generally provide a main terminal location in the basement or ground floor and a wall conduit system to each room or apartment. Conduit systems which are part of the building will usually be furnished, installed, and maintained by the building personnel. For information regarding building conduit systems, consult the plan at the main terminal or contact the building superintendent or other agent designated by the building owner, before planning station wiring. The building owner's agent should be consulted before extending station wiring beyond the provided system. Whenever conduit is provided for telephone wires it should be used if the type and construction are suitable.

7.11 When it is necessary to wire through concrete or similarly constructed floors or walls and no conduit is provided, look for riser shafts, air ducts, or pipes through the floor or wall which can be used to pass the telephone cable through, thereby avoiding the necessity of drilling holes.

7.12 In hazardous locations, such as spaces having explosive atmospheres, wiring should be installed in accordance with the applicable requirements of the NEC. Articles 500 through 517 of the NEC define and discuss different types of hazardous locations and associated wiring requirements. Station apparatus for use in hazardous locations is discussed in Paragrpah 8.5, herein.

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7.13 The NEC requires that communication conductors must not be placed in any raceway, compartment, outlet box, junction box, or similar fitting with conductors of light or power circuits or Class 1 Circuits* unless the conductors of the different systems are separated by a partition. Telephone conductors may be run in the same shaft with electrical power conductors providing either facility is encased in noncumbustible tubing in addition to the normal insulation on the wire, or the two facilities are separated at least two inches.

7.14 Wire or cable should not be placed in locked store rooms, nor on temporary structures unless absolutely necessary.

7.15 Privately owned wire or cable should not be used without a written agreement from the owner. A physical interface should be furnished which provides an accessible test point and line of demarcation between the privately owned facilities and the telephone company's facilities. Without such precautions divided responsibility regarding maintenance could become a problem.

7.16 Where telephone service to numerous locations in a large room is needed it can best be provided by station wire or cable in under-floor duct runs from one or more cable terminals on that floor.

7.17 In the absence of an under-floor duct system, a suspended ceiling and movable poles or posts which have separate compartments for power and telephone wires may be used. Typical poles for this application are made of metal, are of square or rectangular cross section, and extend from floor to ceiling. The lower end is secured by a carpet gripper. The upper end is attached to a "T" bar above the ceiling. Notched ceiling tiles are placed around each pole. Up to eight 25 pair plug-ended cables can be accommodated in each pole. It is recommended that the area to be served be laid out in a 20' x 20' grid pattern and that up to four poles be allocated to serve each 20' x 20' area. A three inch raceway should be provided between the cable terminal and the area above the ceiling. Each 400 square foot area should be served by a two inch branch raceway. The two inch raceways normally will accomodate up to four 25 pair plug-ended cables.

8. STATION APPARATUS

8.1 General installation instructions covering conventional station apparatus are included in PC-5. Installation details applicable to a particular type of station equipment should be in accordance with the manufacturer's instructions. Some types of station equipment and components are polarity sensitive. It is essential, therefore, that all station equipment be connected with the required polarity to insure its proper operation. Equipment manufacturers furnish wiring diagrams and tables of connections with each piece of station equipment. These diagrams and tables show exactly how the equipment is to be connected to insure optimum performance for various classes of services and should be carefully followed. The manufacturer's instructions include consideration of the

* See Article 725 of the 1975 NEC for definition of Class 1 Circuits.

switching equipment, availability of terminals, number of conductors per terminal, and accessibility of terminals.

8.2 Where customer provided station equipment is involved, all wiring and connections should be made through a telephone company furnished "Connecting Arrangement" in accordance with approved tariffs. This matter is discussed further in Paragraph 11.

8.3 Where Automatic Number Identification (ANI) service involves the telephone set wiring it is imperative that the identifying circuits used in the telephone set be compatible with the central office identifying equipment. It is important for the Engineer to determine if long line adapters, loop extenders, and station or subscriber carrier systems will pass ANI signals before specifying continuous mark tip party ANI. See TE & CM-707 for details.

8.4 All telephone sets should be equipped with a dial number card showing the area code, directory number, and if applicable, the Direct Distance Dialing (DDD) access code, circle digit and/or extension number. Pre-printed cards should be used where practicable. If card numbering must be done by the installer a numbering machine should be used.

8.5 If telephone service is needed in hazardous areas, such as areas which have atmospheres of ignitable gas or explosive dust, the telephone set and other equipment is required by Articles 500 through 517, of the NEC, to be of special construction. In general, the Code requires that current-interrupting make and break contacts of push-buttons, hook switches, dial pulse contacts, relays, alarm bells, alarm horns, etc., be suitably enclosed to insure against an arc causing ignition of the surrounding atmosphere. Special telephone instruments which meet the above requirements are available from telephone set suppliers.

8.6 General information on multi-line key systems is included in REA TE & CM-704. Special detailed information for each make and type of key system should be obtained from technical publications of each supplier.

8.7 After completion of each telephone installation the telephone set and circuit should be tested in accordance with the applicable portions of REA Standard PC-4, "Acceptance Tests and Measurements of Telephone Plant."

9. MOBILE HOME OR TRAILER INSTALLATIONS

9.01 Unless the customer specifically objects to direct attachments to the shell of his home, mobile homes and other types of trailers mounted on permanent foundations should be treated as permanent homes and installations should be made in accordance with Paragraph 1 through 6 and 8 of this section.

9.02 Mobile homes and trailers which are expected to be moved require certain deviations from procedures recommended for permanent buildings. Except for the deviations outlined in this subsection all other requirements of this section apply to mobile homes and other types of trailers. The term "trailer" is used throughout the remainder of this subsection to refer to all types of automotive and non-automotive vehicles which require telephone service.

9.03 The provision of telephone plant facilities in trailer parks should be closely coordinated with the electric power contractor, other contractors, and the owner of the park. Advanced planning and coordination can result in significant savings in construction costs by making maximum use of joint trenching, common backboards, and common grounding. Joint planning and construction also minimizes the probability of one utility's forces, or its contractors' forces digging into other utilities' facilities.

9.04 Joint buried electric power and telephone facilities should be installed in accordance with Subsections 30, 31, 35, and 38 of Part 3 of the National Electrical Safety Code (NESC), 1973 Edition, and "Design and Construction of Joint Buried Plant--Electric and Telephone" marked "File with TE & CM-640," dated June 1967. Where joint trenching is used it may be advantageous to install the electric power and telephone service equipment in common housings, or on jointly used posts, to facilitate interconnection of the electric service grounds and telephone grounds. In most instances, however, it is <u>not</u> economical to use common housings because the power company usually needs a separate expensive housing for <u>each</u> trailer, whereas it is practical to serve a group of trailers from a single telephone housing. (See Figure 1).

9.05 Where groups of trailers are to be served and joint construction with the power company is not practicable, the preferred installation is to extend a branch buried cable or buried wire from the main distribution facility to a series of buried plant housings equipped with terminal mounting bars and fuseless station protectors. These housings should be placed along the back lot line between rows of trailers and spaced to economically serve a group of subscribers from each housing by buried wire services. (See Figure 2). Where trailers are served by existing aerial power plant, it is still usually desirable to use buried telephone plant as indicated in Figure 3. In this case, economies may be realized by eliminating telephone housings and making maximum use of joint poles, posts, and backboards for mounting station protectors and facilitating interconnection of grounds.

9.06 If extension of the telephone plant into the trailer park by aerial plant is necessary, the use of lashed cable on poles is recommended. The lashed cable should be terminated in ready access enclosures and a stub cable should be extended down the pole to station protectors. Buried wire should be extended to each trailer. Single or multi-pair station protectors

should be mounted on the poles to serve each trailer. An effective ground is needed for the station protectors, and in most instances can be obtained by bonding to electric grounds or to a metallic water pipe system (See Figure 4). Aerial drops should be avoided, but if used they should not be attached to the shell of a transient trailer.

9.07 A fuseless station protector for each trailer served from a particular distribution point should be mounted in (1) a telephone buried plant housing equipped with an offset terminal mounting bar, (2) in the telephone compartment of a joint electric power and telephone housing, or (3) on a designated portion of a common backboard, post, or pole. Multi-pair station protectors should be used to the extent practicable where protection of more than one circuit is needed. Care must be exercised to determine that the multi-pair protector will fit into the selected buried plant housing.

9.08 As many as six subscribers may be conveniently served from a single buried plant housing. Selection of the housing should be based on the required number of fuseless type station protectors. The station protector should not be more than approximately 60 feet from the trailer it protects. In the run between the protector and the trailer, the buried wire should not be placed in the same trench at random separation with power supply conductors operating at more than 300 volts to ground.

9.09 In high density parks it is important to protect telephone facilities against accidental mechanical damage, tampering, and vandalism by enclosing them in a buried plant housing and burying all wires that extend beyond the housing. In no case should station wire be used in an above ground span from a post or housing to the trailer.

9.10 Where practicable, buried plant housings should be located adjacent to trees, posts, poles, or other objects rather than in open areas, thereby avoiding the break up of areas useful for other purposes, and reducing the chance of damage by vehicles. Metal riser guards and plastic cable guards should be specified to provide additional physical protection to exposed wires where needed.

9.11 Where it is not practicable to serve a group of trailers from a single buried plant housing, and electric service structures are not available for mounting protectors, one or two trailers may be served economically from buried plant by mounting the protectors on a "mobile home post".

9.12 The preferred entrance to trailers should be made by extending a two pair or larger #22 AWG filled buried wire from the protector to the trailer through a hole in the floor. Installation details of this method and an alternate method are discussed in PC-5.

9.13 The NEC has special detailed requirements for grounding electric wiring and services in mobile homes, but does not specifically cover telephone grounds. It is important to understand the electric service grounding requirements in order to avoid defeating the NEC objective through the telephone grounding arrangement.

9.131 The principle differences in NEC electric service requirements for trailers and fixed homes are: (1) The electric service equipment and grounding electrode are located adjacent to, rather than, directly on or in the trailer; (2) an electric load center with circuit breakers, or switches and fuses, must be furnished with both a grounding bus and an insulated neutral; (3) the neutral conductors of all circuits in the trailer must be insulated throughout their length and in no case should any neutral conductor be connected to the shell or chassis of the trailer; (4) all exposed non-current-carrying metal parts including the metallic shell and chassis of the trailer should be bonded together through the grounding bus of the distribution panel, which in turn is connected to the ground electrode via the green conductor of the power cord.

9.132 The purpose of these requirements is to prevent return current from flowing in any portion of the trailer frame, shell, or other non-current-carrying metal parts. If return current should flow in the shell of a trailer isolated from the surrounding earth by rubber tires, the shell would be at a voltage above ground potential. A person standing on the ground but contacting the trailer shell would receive a shock.

9.14 Because not every trailer has electric wiring which complies with the NEC requirements, the trailer frame should be grounded as part of the telephone installation by connecting it to the shield of the buried service wire. The use of a beam clamp is recommended for mechanically attaching the service wire and electrically bonding the shield to the chassis. If ringing and signaling ground conductors are required the conductors of a spare pair should be used from the trailer back to the protector.

9.15 For transient trailer courts consideration should be given to providing an enclosure at the trailer pad to store a length of buried service wire which connects to the connecting block in the trailer. The enclosure should consist of polyvinyl chloride (PVC) pipe about one foot in length by six inches in diameter, with a cover. It should be installed in accordance with PC-5.

9.16 Where isolated trailers not in trailer courts require service, the preferred procedure is to use a two pair or larger #22 AWG filled buried wire service extended from the main lead. The protector should be mounted on a "Mobile Home Post," treated wooden post, or metal stake in accordance with PC-5.

10. PAY STATIONS

10.1 Pay station drop and station wiring should be installed in accordance with all the preceding applicable paragraphs, REA Form 511g, and PC-5. Pay station wiring should be protected from damage by concealment in a wall or by covering with a suitable molding. Detailed information on pay station service is included in TE & CM-703.

10.2 A careful study by the Engineer or Manager is needed to provide adequate service to the public.

10.3 Where economically feasible, indoor pay stations should be installed in booths to insure privacy and minimum background noise.

10.4 Outdoor pay stations should always be installed in a full or half length booth. Buried or underground telephone and electric services and/or station wiring should be used in preference to aerial services wherever practicable. For more detailed information refer to TE & CM-702 "Booths and Special Fittings," and TE & CM-703.

10.41 The preferred outdoor installation, where practicable, consists of: (1) Terminating the buried or underground service on a station protector mounted in or on an adjacent building; (2) extending a buried wire from the protector to the pay station by means of buried conduit furnished by the customer.

10.42 If the owner of the premises cannot or will not provide a conduit, the next choice should be a trenched buried wire from the protector on the building to the pay station in the booth.

10.43 If there is no suitable protector location on an adjacent building, an aerial or buried service should be run from a pole or buried plant housing directly to the booth. When an aerial service is necessary, a mast attached to the booth may be needed to provide proper overhead wire clearances. The protector should be mounted on the upper rear portion of the booth. Station wire should then be used to extend the circuit from the protector to the pay station through wiring channels provided in the booth.

11. INSTALLATION OF AUXILIARY EQUIPMENT

11.1 Auxiliary equipment includes all types of devices which are intended to operate in conjunction with telephone sets. It also includes devices which operate independently from telephone sets but use telephone circuits for transmission and signaling. Some auxiliary devices are powered locally by batteries, or by commercial 120V 60Hz power. Others may be powered from a central office or other remote point by power transmitted over a telephone circuit.

11.2 The Engineer or Installation Supervisor should specify installation of an auxiliary device only after carefully checking its power requirements and operating characteristics to determine that it is suitable for connection to voice grade telephone circuits, which in turn may be connected to the DDD network.

11.21 The Direct Distance Dialing (DDD) network can be harmed by:

1) Excessive power and poor wave form of signals.
2) Hazardous voltages.
3) Equipment and circuits which have inadequately balanced impedance to ground.

Protection against these "harms" is specifically provided for by requirements in the applicable tariffs.

11.22 Tariffs covering most types of customer owned equipment require them to be connected to telephone company circuits only through a protective coupler or "Connecting Arrangement" which insures that "harmful" characteristics of customer owned equipment will not be transmitted to the telephone company's circuits.

11.23 An alternative to permit customer owned equipment which has been certified by an independent test laboratory to be directly connected (hard wired) to telephone company circuits is being considered by the Federal Communications Commission (FCC). At the present time there is no indication as to when a decision on this matter will be reached, or to what extent State Commissions will follow the FCC's decision. Tariffs of each local company will probably require revision to put any FCC or State Commission ruling on interconnection into effect. Engineers should, therefore, be guided by the tariffs in effect at the time of the installation.

11.3 All auxiliary equipment which operates from commercial 120V, 60Hz, power should be listed by Underwriters' Laboratories, Inc.

11.4 All power wiring for auxiliary equipment should comply with the applicable portions of Article 725 of the NEC. Transmission and signaling circuits for auxiliary equipment should comply with the applicable portions of Article 725 and/or Article 800 of the NEC. In this connection it should be noted that Paragraph 725-7 of Article 725 states that remote control and signal circuits which use conductors in the same cable with telephone circuits are classified as telephone circuits and must comply with Article 800 of the NEC.

12. INSTALLATION OF CARRIER EQUIPMENT IN CUSTOMERS' PREMISES

12.1 Carrier equipment which is designed to be mounted in or on a customers' premises, and which is powered from commercial 120V 60Hz power should be listed by Underwriters' Laboratories.

12.2 Carrier equipment which is designed to be mounted in or on a customer's premises shall be located on the customer's side of a standard station protector, preferably in a basement, utility room, or storage area. If the equipment is enclosed in a weather resistant housing it may be mounted on the outside of the customer's building if not objectionable to the customer.

12.3 Mounting and wiring of the equipment should be done in strict accordance with the carrier supplier's instructions.

12.4 Metallic housings, chassis, and circuit ground points of carrier equipment must be connected to the ground terminal of the station protector, or directly to the station grounding conductor or ground electrode.

12.41 The NEC requires telephone station grounds to be interconnected with power grounds at customers' premises because of shock and fire hazards. If the carrier supplier specifies that its equipment should not be grounded to a power system ground, it should not be installed in or on the customers' premises.

12.5 Station wire in accordance with PE-20 should normally be used to wire carrier equipment.

12.6 The same techniques should be used for mounting and wiring carrier equipment as are used for other types of station equipment.

TABLE 1

STATION PROTECTOR GROUNDING GUIDE

Satisfactory Water Ground /3	Type of Power Service		Electric Service Ground at Building		Telephone Protector Grounding Unit Choice /2 (It is the engineer's responsibility to determine the practicability of the unit specified.)		
	MGN /4	Other Than MGN /4	To Water Pipe	To Rod	First /1	Second	Third
Yes	Yes	-	Yes	Yes	P1-1F, P1-2F, or P1-3F	P1-7F	
	-	Yes	No	No	P1-1F	P1-7F	
	No	No	No	No	P1-1F	P1-7F	
	Yes	-	Yes	No	P1-1F	P1-7F	P1-3F
	Yes	Yes	Yes	No	P1-1AF	P1-2F or P1-3F	-
	-	Yes	No	Yes	P1-1AF	P1-1F	P1-4F or P1-5F
	-	Yes	Yes	Yes	P1-1F	P1-7F	P1-4F or P1-5F
No	No	No	No	No	P1-8F	-	-
	Yes	-	No	Yes	P1-1AF	P1-2F or P1-3F	P1-8F
	Yes	-	Yes	Yes	P1-1F, P1-2F, or P1-3F	P1-7F	-
	-	Yes	No	Yes	P1-9F or P1-10F	P1-4F or P1-5F	P1-8F
	-	Yes	No	No	P1-8F and bond to electric service conduit or electric service equipment enclosure /5		
	Yes	-	No	No	P1-8F and bond to electric service conduit or electric service equipment enclosure /5		

NOTES:

/1 Fuseless protectors should always be used except where requirements for their use cannot be met.

/2 Refer to REA Form 511g for description of protector assembly units.

/3 Buried metallic water systems with more than ten feet of buried metallic pipe are considered to be satisfactory water system grounds. Unsatisfactory water system grounds are those with less than ten feet of buried metallic pipe. Where the status of a water pipe as a ground electrode is difficult to determine, it is permissible to use a P1-1AF, P1-9F, or P1-10F as first choice; P1-2F or P1-3F as second choice (if MGN power system); P1-4F or P1-5F as second choice (if non-MGN power system); and P1-8F as third choice.

/4 A common multigrounded neutral (MGN) electric power supply system is a "Wye" connected system which has solidly interconnected primary and secondary neutrals, and at least four grounds in every mile of line, exclusive of grounds at customers' premises.

/5 Notify customer that power ground is required <u>at building</u> by NEC.

ALTERNATE STATION PROTECTOR GROUNDING GUIDE

TYPES OF ELECTRIC SERVICE AND GROUNDING METHODS

1. MGN System grounded to an acceptable metal water pipe.
2. MGN System on ground rod (or other made electrode), no connection to water pipe.
3. Non-MGN System on acceptable metal water pipe.
4. Non-MGN System on ground rod (or other made electrode).
5. Electric service not grounded at building.
6. No electric service.

WATER PIPE	ELECTRIC SYSTEM CONDITION	PROPER PROTECTOR GROUNDING PROCEDURE
Acceptable-i.e., at least 10 feet of buried metallic pipe in moist soil.	1 or 3	Ground protector to metallic water pipe or to electric service grounding conductor.
	2 or 4	Ground protector to metallic water pipe and bond electric ground to water pipe with #6 AWG copper if not already bonded.
	5 or 6	Ground protector to metallic water pipe, and if 5, See footnote *.
Metallic interior water piping not acceptable because of plastic entrance or insulating joints.	2	Ground protector to MGN grounding conductor, electric ground rod, electric service conduit, or electric service equipment enclosure. Bond electric ground to metallic water pipe with #6 AWG copper, if not already bonded.
	4	Ground protector to telephone ground rod or other made electrode. Bond to electric grounding conductor, electric ground rod, electric service conduit, or electric service equipment enclosure and to interior metallic water pipe. Use #6 AWG copper for bonding to electric power. Use #14 AWG copper to bond to water pipe.
	5 or 6	Ground protector to telephone ground rod, bond to interior metallic water pipe with #14 AWG copper. If 5, bond with #6 AWG copper ground wire to electric service conduit or electric service equipment enclosure. *
No metallic water pipe or not possible to connect to metallic water pipe.	2	Ground protector to MGN grounding conductor, electric ground rod, electric service conduit, or electric service equipment enclosure.
	4	Ground protector to telephone ground rod and bond to electric grounding conductor, electric ground rod, electric service conduit, or electric service equipment enclosure.
	5 or 6	Ground protector to telephone ground rod or other made electrode.** If 5, bond with #6 AWG copper ground wire to electric service conduit or electric service equipment enclosure. *

* Customer should be informed of need for an electric ground at the building to meet N.E.C. requirements.

** Special assembly unit required.

TABLE 2

NATIONAL ELECTRICAL CODE AND REA FUSING COORDINATION REQUIREMENTS

AERIAL LINE PLANT TO DROP WIRE

TYPE OF AERIAL PLANT	STATION GROUND 1/	PROTECTOR TYPE	FUSIBLE LINK REQUIRED BY N.E.C.	REMARKS
Cable	Preferred Type	Fuseless 2/	Yes 3/	#24 AWG Gauge Leads on Terminal Blocks
	Other	Fused	No	See Form 511a for Construction Exceptions
Multi-Pair Distribution Wire	Preferred Type	Fuseless 2/	Yes	#24 AWG Gauge Leads on Terminal Blocks
	Other	Fused 4/	No	
One Pair Figure 8 Distribution Wire	Preferred Type	Fuseless 2/	Yes	#20 AWG Gauge Copper Steel Bridle Wire
	Other	Fused 4/	No	REA Requires #20 AWG Copper Steel or #14 AWG Copper Bridle Wire
Open Wire	Preferred Type	Fuseless 2/	Yes	#20 AWG Gauge Copper Steel Bridle Wire Link
	Other	Fused 4/	No	REA Requires #20 AWG Copper Steel or #14 AWG Copper Bridle Wire

1/ The term "Preferred Type" as used in this table is intended to cover multigrounded power neutrals, and/or water pipe grounds having more than ten feet of buried length as defined in NEC 250-81. The term "Other Type" refers to grounds rods and water pipes not meeting the definition of NEC 250-81.

2/ Includes gas tube protectors.

3/ Required only for cable gauges coarser than 24 gauge.

4/ Only fused type protectors permitted.

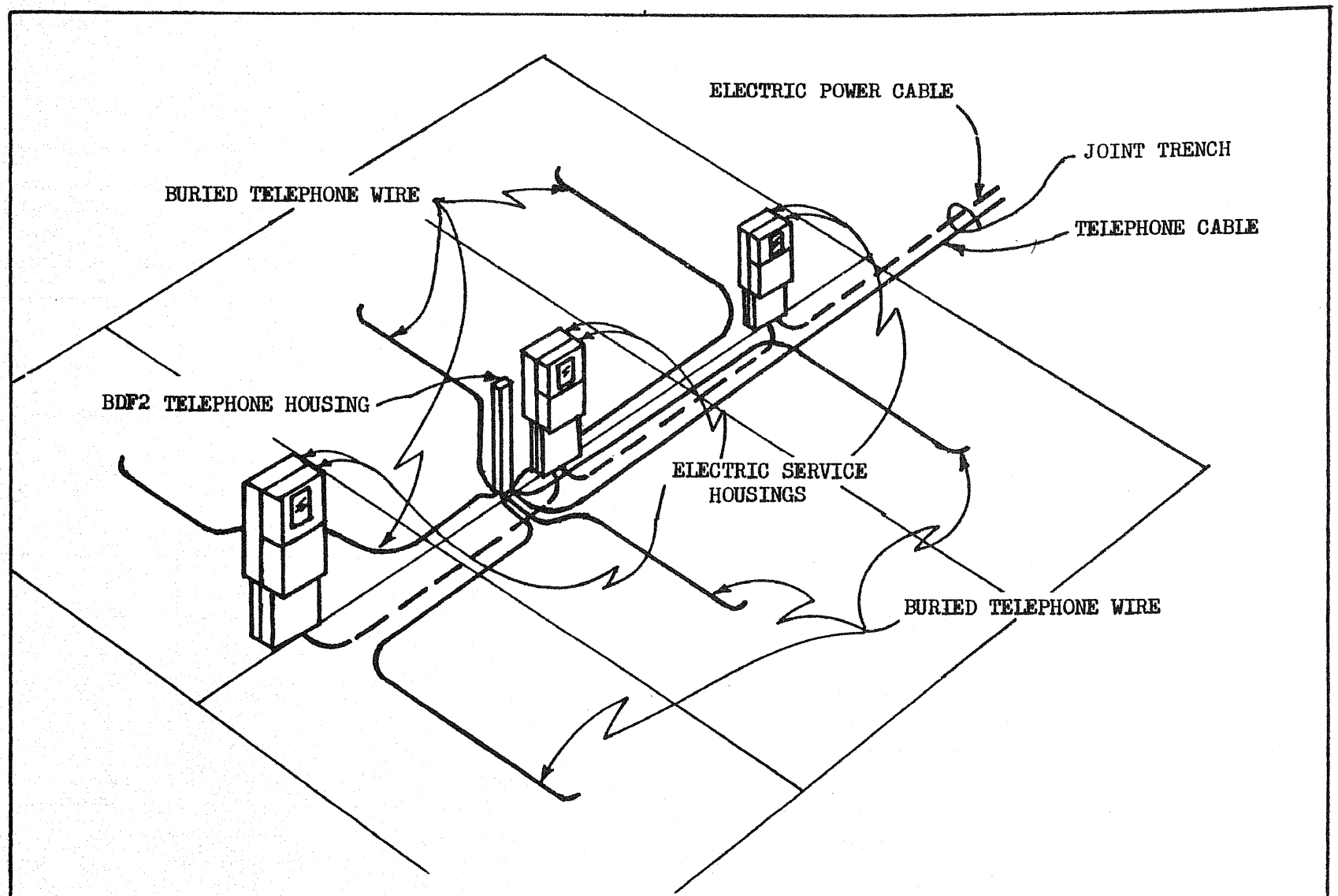

FIG. 1 -JOINT BURIED POWER & TELEPHONE SERVICE TO TRAILER PARKS

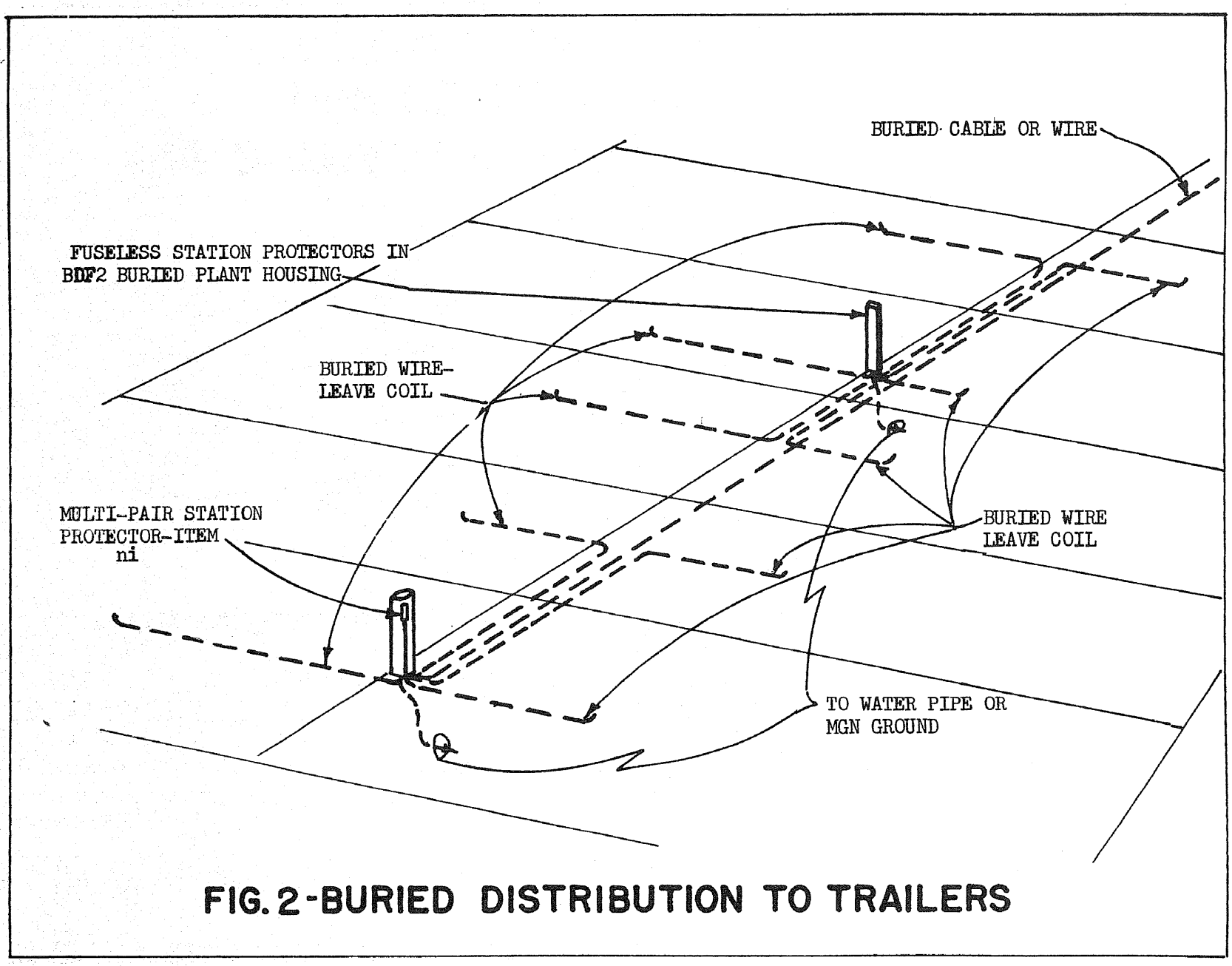

FIG. 2-BURIED DISTRIBUTION TO TRAILERS

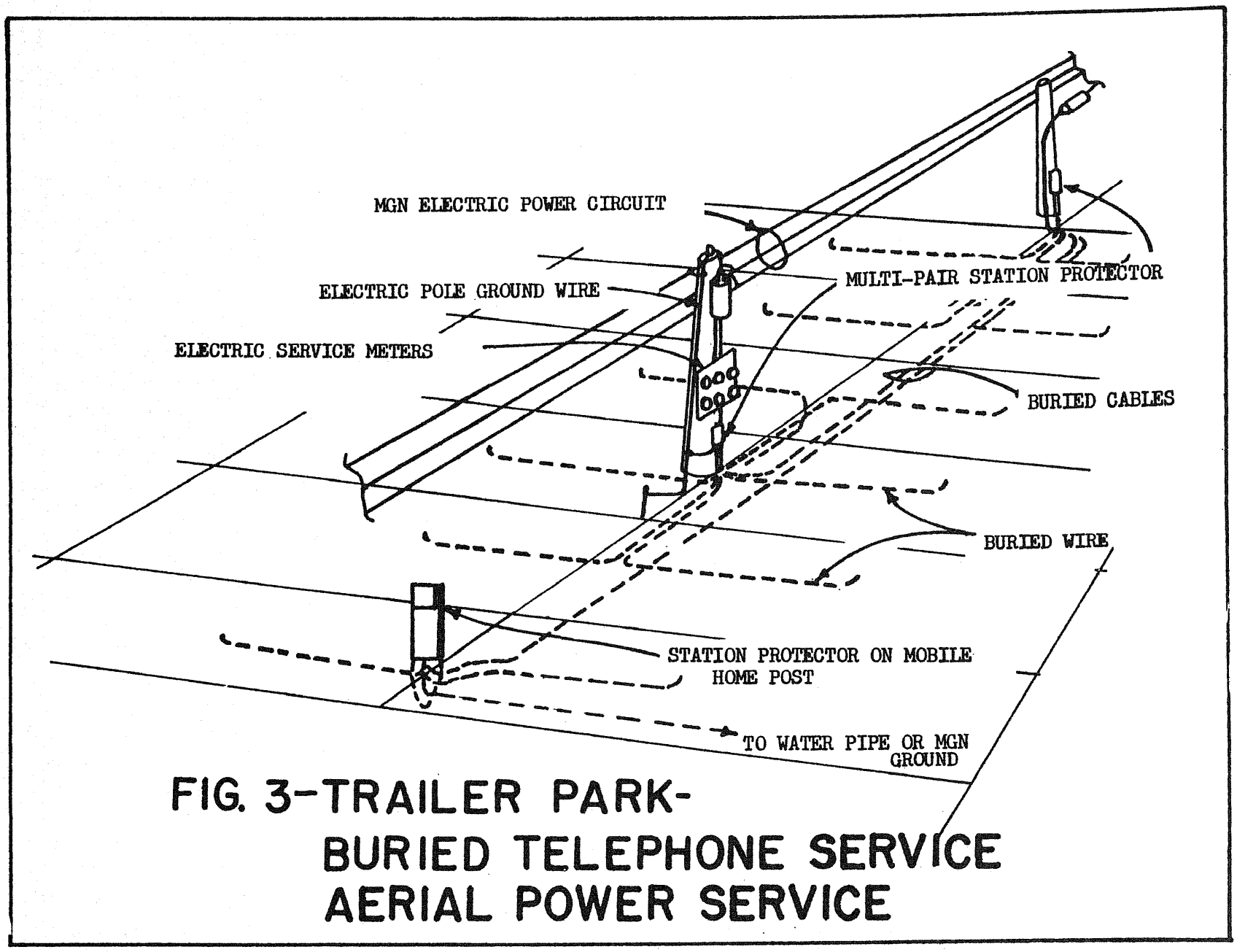

FIG. 3-TRAILER PARK-
BURIED TELEPHONE SERVICE
AERIAL POWER SERVICE

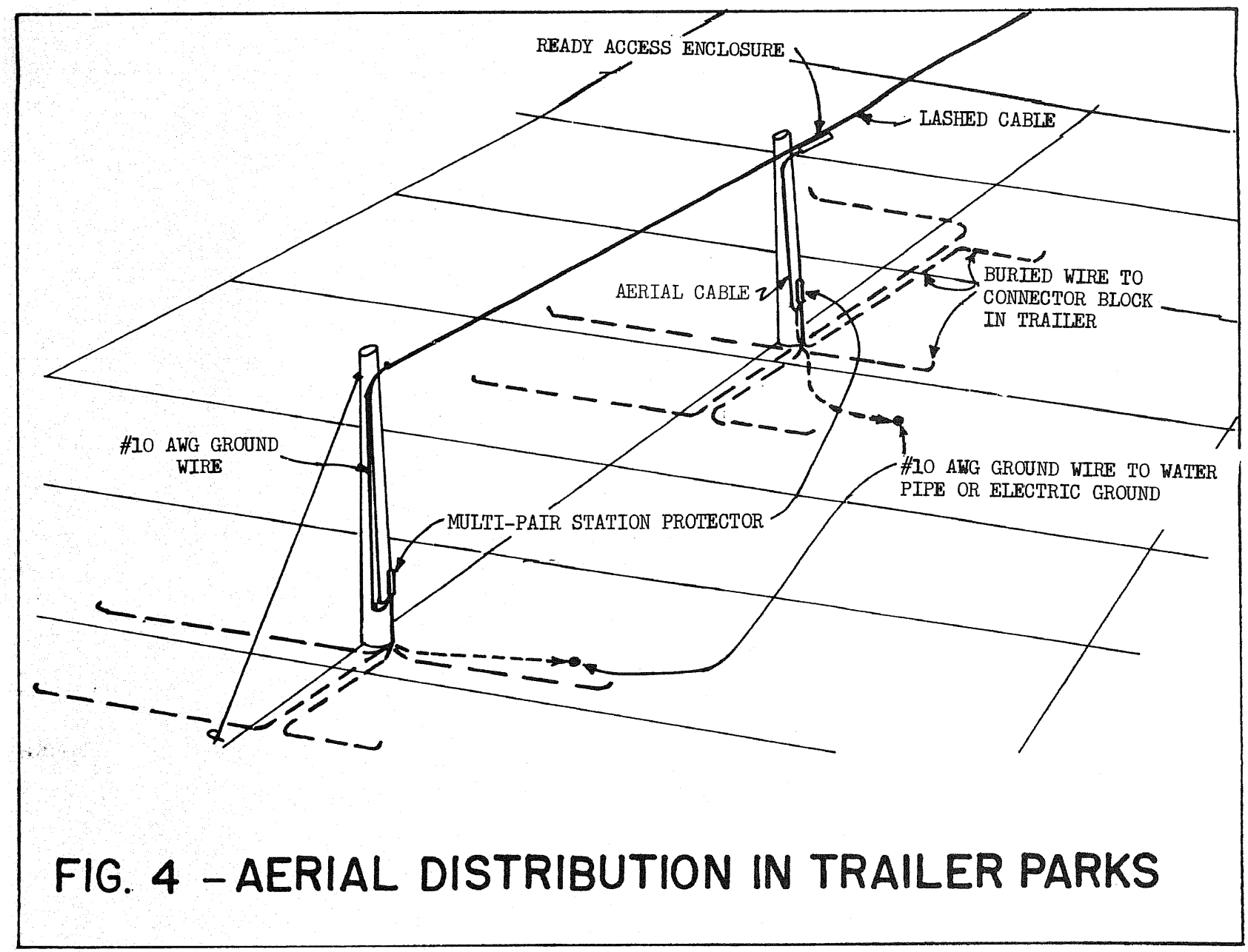

FIG. 4 – AERIAL DISTRIBUTION IN TRAILER PARKS